JPJO 6 (2) (2021) 229-235

Jurnal Pendidikan Jasmani dan Olahraga

Available online at:
https://ejournal.upi.edu/index.php/penjas/article/view/38290
DOI: https://doi.org/10.17509/jpjo.v6i2.38290

Does Physical Fitness Correlate with IQ? A Study among Football Student-Athletes

Panuwun Joko Nurcahyo[1]*, Kusnandar[1], Didik Rilastiyo Budi[1], Arfin Deri listiandi[1], Henie Kurniawati[2], Rindha Widyaningsih[2]

[1]Physical Education Study Program, Universitas Jenderal Soedirman, Indonesia
[2]Universitas Islam Negeri Prof. K.H. Saifuddin Zuhri Purwokerto, Indonesia

Article Info

Article History :
Received August 2021
Revised August 2021
Accepted August 2021
Available online Septemeber 2021

Keywords :
Football Student-Athletes, Intelligence Quotients, Physical Fitness, Vo2Max

Abstract

This study aimed to determine the relationship between the level of physical fitness with intellectual intelligence (IQ) in soccer athletes. The research method uses the correlational method. The sample in this study were 13 male soccer athletes who were members of the football Club at the college level. The sampling technique used was purposive sampling. The research instrument used to measure students' physical fitness was the Multilevel Fitness Test (MFT). Meanwhile, the measurement of intellectual intelligence (IQ) uses an IQ test with Standard Progressive Matrices (SPM) test. Data analysis used a correlation test to confirm the relationship between physical fitness and intellectual intelligence (IQ). The results showed that the male soccer athletes' average level of physical fitness (Vo2 Max) was in a good category. The intermediate IQ level is in the High Average category. The correlation test shows a linear relationship between physical fitness and intellectual intelligence (IQ). The better the physical fitness, the higher the intellectual intelligence.

✉ Correspondence Address : Jl. Profesor DR. HR Boenyamin No.708, Banyumas, Indonesia
E-mail : panuwun.nurcahyo@unsoed.ac.id

INTRODUCTION

Physical fitness is an important factor that an individual should own to carry out various activities. Physical fitness is defined as the body's ability to perform various physical activities without experiencing excessive fatigue and remain fit in the next day to perform the next physical task (Monteiro et al., 2019; Suhartoyo et al., 2019; Listiandi, Budi, et al., 2020). Furthermore, physical fitness is an essential aspect in the psychomotor domain which aims to develop biological abilities and physiological functions of body organs (Giriwijoyo and Sidik, 2012; Budi, 2015; Kusnandar et al., 2019). Physical fitness requires consistent training to maintain the body to be in a healthy and fit condition.

One of the crucial physical fitness components to be developed is aerobic endurance (Vo2Max). Aerobic endurance is important to maintain the body's ability to perform aerobic activities for a long period (Mishra, Pandey, and Chaubey, 2015; Kharisma and Mubarok, 2020; Quindry, Williamson-Reisdorph, and French, 2020). Excellent aerobic endurance is a crucial element for athletes in complex sports, such as football. Football game requires a long duration, wide-field, high mobility, and complex movement skills (Bennike, Wikman, and Ottesen, 2014; Qohhar and Pazriansyah, 2019; Sucipto et al., 2019; Budi and Widyaningsih, 2021).

According to the results of previous studies, physical fitness, in the form of aerobic endurance (Vo2Max), has a close relationship with endurance (stamina) for football players. The poor stamina conditions will result in uncontrolled basic techniques and inaccurate, weak, and wrong kicks (Setiawan, Soetardji and Nugroho, 2014; Mishra, Pandey and Chaubey, 2015). Other studies also show that Vo2Max is a key factor in football, where a player with good Vo2Max can play football better (Milanović et al., 2015; Manisha, 2018). In its development, football games require an excellent physical fitness condition related to aerobic endurance component (Vo2Max) and a good Intelligence Quotients (IQ) level. Football players require the proper decision-making when carrying out basic techniques, playing the techniques, and cooperating with teammates. Football skills are possibly influenced by Intelligence Quotients (IQ), Emotional Quotients (EQ), and playing position (Najah and Rejeb, 2015). In a game, decision-making requires a good Intelligence Quotients (IQ) level. The results show that football players with a better IQ level can perform soccer skills and techniques well (McLean et al., 2017).

The results of other studies regarding the importance of IQ in football games state that there is a positive correlation between IQ and EQ and football player performance (Nakisa and Rahbardar, 2021). The results of previous studies conclude that Intelligence Quotients (IQ) is one of the critical factors in supporting the football athlete's performance during training and matches. Physical fitness, especially aerobic endurance (Vo2Max) and Intelligence Quotients (IQ), are needed by football players to perform good playing techniques. Research on the relationship between physical fitness and learning achievements has been carried out several times. The results of previous studies show a consistent positive relationship between overall fitness and academic achievements (Donnelly et al., 2017). Other research shows that students with better physical fitness have better learning outcomes than students with low physical fitness (Shook, 2017).

The problem occurring in football athletes at the college student level is the lack of consistency in the regular physical fitness measurement. These irregular measurements impact the absence of precise data regarding the athlete's physical fitness (Vo2Max) level. Another problem is the lack of supporting data on the athlete's performance, such as the Intelligence Quotients (IQ) level. IQ measurements on the Football athletes at the University level. In addition, the supporting factors for the athlete's performance, other than physical factors, have never been administered earlier.

Research on the relationship between the athlete's physical fitness or Vo2Max and the Intelligence Quotients (IQ) level has been carried out on professional athletes several times. However, research on the relationship between physical fitness level (Vo2Max) and football athlete Intelligence Quotients (IQ) at the college student level has not been carried out; thus, it becomes an important issue to study. Therefore, this research aimed to determine the relationship between physical fitness (Vo2Max) level and Intelligence Quotients (IQ) level of football athletes at the Sport student level.

METHODS

This study used a correlational method with a cross -sectional design to determine the relationship between Physical Fitness and Intellectual Intelligence (IQ) of Football Athletes at college students.

Participants

The population of this study was male students-athletes who were active in the Football Club at University in Indonesia. The sample's age of this study was 18 -20 years involving 13 athletes. The sampling technique used was purposive sampling (Sugiyono, 2019). The sample inclusion criteria included physically healthy and not injured. The exclusion criteria for the sample included being sick or injured during the data collection process.

Instrument

The research instrument used was the Multilevel Fitness Test (MFT) to measure the Vo2Max level. MFT test norms based on Ismayanti (2008) dan Nurhasan (2011) presented in Table 1

Table 1. Aerobic Endurance Norms (VO2Max)

No	Category	VO2max
1	Very Good	>51.6
2	Good	42.6–51.5
3	Fair	33.8–42.5
4	Poor	25.0–33.7
5	Very Poor	<25.0

Table 2. Intelligence Classification Based on Standard Progressive Matrices (SPM) Test

No	Category	IQ Test Result
1	Very Superior	> 140
2	Superior	120-139
3	High Average	110–119
4	Normal or Average	90–109
5	Low Average	80–89
6	Borderline Defective	70-79
7	Mentally Defective	30-69

IQ was measured using the Standard Progressive Matrices (SPM) test. The SPM test has been used in various countries with a test validity of 0.64 and tests the reliability of 0.84 (Suwartono, Amiseso, and Handoyo, 2017; Albokai and Al-subaihi, 2021). The test norm criteria of SPM can be seen in Table 2.

Procedure

The MFT test was carried out by running back and forth for 20 meters by following the music rhythm and was declared complete when the testee was late to the music rhythm twice; the number of lap attainment was then calculated (Ismayanti, 2008; Nurhasan, 2011). The procedure of the MFT test can be seen in Figure 2.

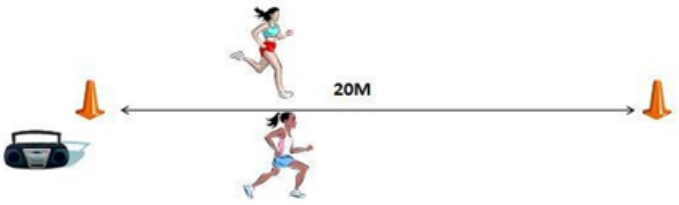

Figure 2. MFT Test to Measure Physical Fitness (Vo2Max)

Intelligence Quotient (IQ) was measured by involving a credible psychological test institution showed by having formal legality as a testing agency that already had a business practice license and a psychologist who had obtained a practice permit from the Indonesian Psychological Association. The SPM IQ test determines a person's ability or general intelligence provided with 120 minutes for processing the questions (Rahmadani, 2019).

Data Analysis

The data were analyzed using the SPSS application by conducting a prerequisite test using the normality and linearity tests. To find out the relationship between variables, a correlational test was used. When the value of Sig < 0.05, then there was a relationship between variables. When the value of Sig > 0.05, then there was no relationship between the research variables.

RESULT

Research on the Relationship between Physical Fitness and Intelligence Quotient (IQ) Levels of the Football Activity Unit students of Jenderal Sudirman University involved 13 male students. The research results included the physical fitness test results, using the MFT test, and Intelligence Quotient (IQ) test results, using the Standard Progressive Matrices (SPM) test.

A physical fitness test was carried out to determine the cardiorespiratory endurance level possessed by participants. The test used was the Multilevel Fitness Test

(MFT). The test results are shown in Table 3.

Table 3. VO2Max and IQ Result Test Results

	Mean	Criteria
VO2Max	44.12+7.42	Good
IQ Result	112.15+14.51	High Average

The fitness test results using the MFT test found that participants' average physical fitness (Vo2Max) level was 44.12 (good category) with a standard deviation value of 7.42. Therefore, the data concluded that the Football Activity Unit students' physical fitness condition (Vo2Max) was in a good category.

The Intelligence Quotient (IQ) test was conducted to determine the cognitive intelligence level possessed by participants. The test to measure the IQ level was the Standard Progressive Matrices (SPM) test. Table 3 concludes that Football Activity Unit students were in the above-average IQ category level.

Normality test is a prerequisite test that needs to be done to determine whether the data is normally distributed or not. The normality test of the data used the SPSS application. When the value of Sig > 0.05, the data were declared normal. Meanwhile, when the value of Sig <0.05, the data was reported not normally distributed.

The significance value of physical fitness was 0.526, and the significance value of IQ was 0.101. Therefore, it concluded that the data were greater than 0.05, meaning that the data were normally distributed. Then, a linearity test was conducted using SPSS. When the value of Sig> 0.05, the data were declared linear.

The test found that the significance value between fitness and IQ was 0.061. Therefore, it can be concluded that the value was greater than 0.05; thus, the data were declared linear.

A correlation test was conducted to determine whether there was a relationship between physical fitness and Intelligence Quotients (IQ). The correlation test used bivariate correlation with the help of SPSS. The correlation test states that there is a relationship between two variables if the value of Sig < 0.05. Whereas, if the value of Sig > 0.05, then there is no relationship between the two research variables. The results of the correlation test are in Table 4.

Table 4. Correlation Test between Physical Fitness and IQ

Correlations			
		Fitness	IQ
Fitness	Pearson Correlation	1	.926**
	Sig. (2-tailed)		.000
	N	13	13
IQ	Pearson Correlation	.926**	1
	Sig. (2-tailed)	.000	
	N	13	13

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4 shows that the value of Sig (2-tailed) was 0.000; thus, it concluded a significant relationship between the physical fitness level and Intelligence Quotients (IQ). The better the fitness you have, the better your Intelligence Quotients will be.

DISCUSSION

The results showed that the physical fitness level, in the form of cardio-respiratory endurance (VO2 Max), of the football Club at the college level athletes was in a good category. It might be because the students still routinely did the physical activity, football practice, and football matches. The research results show that physical fitness will positively contribute to the growth and development of body functions in school-age children from elementary to university (Galih and Suharjana, 2019; Listiandi, Kusuma, et al., 2020). The more programmed the physical activity, the better the physical fitness.

For football players, physical fitness is an important factor in supporting skills in performing various basic techniques and football techniques. The results show that football athletes can perform various skills better during training and matches with an excellent physical condition (Popovic et al., 2014; Hogarth, Burkett and McKean, 2015; Sharma, 2015; Firdausi and Simbolon, 2020). For this reason, football athletes at the college student level need to maintain and improve their physical condition and physical fitness.

The physical fitness component needed by soccer players during training and matches is aerobic endurance (Vo2Max). Vo2Max is a person's ability to consume oxygen optimally during physical activity (Manisha, 2018; Rusdiana et al., 2020). Therefore, football players need to have a good Vo2Max condition to

support their performance on the field. The study results on the importance of Vo2max for football players show that the higher the Vo2max possessed by athletes, the better the football basic technical skills they have (Ilissaputra and Suharjana, 2016; Vasileios et al., 2018).

The Intelligence Quotients (IQ) test shows that, on average, the football Club at the college level athletes was in the high average category. This condition is relevant to the education level of students, namely the university level. Students' Intelligence Quotients (IQ) play a role in completing academic studies and help students achieve non-academic achievements, especially in football. IQ is an essential element that often defines success in sports that require accurate and fast thinking, such as football, volleyball, basketball, tennis, etc. (Nakisa and Rahbardar, 2021). Latifah et al. (2017) explain that the intelligence (IQ) level in sports is crucial for sports performance and achievements.

The results of this study also support previous research stating that the Intelligence Quotients (IQ) level affects the skills possessed by football athletes (Nakisa and Rahbardar, 2021). The results of another study show that there is a significant relationship between IQ and handball playing skills (Shalar et al., 2020). Based on these results, IQ needs to be a severe concern of the football achievement coaching process. Analysis of the research data shows a strong relationship between the physical fitness level and Intelligence Quotients (IQ) of Football Activity Unit students of Jenderal Sudirman University. The results of this study indicate that good physical fitness will affect a good level of Intelligence Quotients (IQ). The combination of these two components will help students to achieve success in academic and non-academic aspects.

The results of this study also support previous research saying that physical fitness, namely aerobic endurance (Vo2Max), is positively related to Intelligence Quotients (Ishihara et al., 2017; Gil-Espinosa et al., 2020). The results of other studies also show that good cardiovascular fitness is associated with better cognitive function (Hötting and Röder, 2013; Douw et al., 2014). The higher the cardiovascular fitness level, the better the learning outcomes due to the increased cognitive function (Singh and McMahan, 2006; Putra, Messakh, and Adhitya, 2020). Research-based literature support provides important information that excellent physical fitness supports an excellent metabolic process in the body and ultimately positively impacts Intelligence Quotients (IQ). Institutions or organizations absolutely require programmed physical activity activities for their athletes so that their fitness and Vo2Max could reach an optimal level.

Future research is expected to focus more on the relationship between IQ and motor skills. It is also crucial for further research to examine physical fitness at different IQ levels, such as junior high school and senior high school student levels, with a larger number of samples.

CONCLUSION

Based on the results and discussion, the study concludes that the overall physical fitness (Vo2Max) of the football Club at the college level athletes was in a good category. Meanwhile, the Intelligence Quotients (IQ) level possessed by the football Club at the college level was in the high average category. Therefore, it summarizes a significant relationship between physical fitness (Vo2Max) and Intelligence Quotients (IQ) of the football Club at the college level athletes. Thus, the better the fitness level, the better the intellectual intelligence (IQ) will be.

For further research, it is recommended to examine the relationship between Intelligence Quotients (IQ) and football performance skills. In addition, it is also important to conduct a study on the effect of physical fitness and IQ on basic technical skills or football performance techniques carried out with more samples or in different types of sport.

ACKNOWLEDGEMENT

The researchers express their gratitude to the LPPM of Jenderal Sudirman University, who has contributed to this research through the research grant for the Competency Improvement Research scheme.

CONFLICT OF INTEREST

The authors declared no conflict of interest.

REFERENCES

Albokai, H. and Al-subaihi, A. A. (2021) 'Standard Progressive Matrices (SPM): Validity and Reliability', International Journal of Innovation, Creativity and Change, 15(4), pp. 276–293.

Bennike, S., Wikman, J. M. and Ottesen, L. S. (2014) 'Football Fitness – A New Vesion of Football A Concept for Adult Players in Danish Football Clubs', Denmark: Scandinavian Journal of Medicine & Science in Sport volume 24 number 1.

Budi, D. R. (2015) 'Pengaruh Modifikasi Permainan Vobas dan Kebugaran Jasmani Terhadap Peningkatan Kerjasama Siswa dalam Pembelajaran Penjas di SMP', Thesis. Available at: http://repository.upi.edu/id/eprint/17605.

Budi, D. R. and Widyaningsih, R. (2021) 'Revealing Fanaticism of Football Supporters : Mass Psychology Perspective', 24(3).

Donnelly, J. E. et al. (2017) Physical activity, fitness, cognitive function, and academic achievement in children: A systematic review, Medicine and Science in Sports and Exercise. doi: 10.1249/MSS.0000000000000901.Physical.

Douw, L. et al. (2014) 'A healthy brain in a healthy body: Brain network correlates of physical and mental fitness', PLoS ONE, 9(2). doi: 10.1371/journal.pone.0088202.

Firdausi, D. K. A. and Simbolon, M. E. M. (2020) 'Physical Fitness of Female Soccer Players based on Playing Positions', Jurnal Pendidikan Jasmani Dan Olahraga, 5(2), pp. 134–142.

Galih, A. and Suharjana, S. (2019) 'The Physical Fitness Gap between Strikers and Defenders in Football Extracurricular Programs', Jurnal Pendidikan Jasmani dan Olahraga, 4(2), pp. 155–159. doi: 10.17509/jpjo.v4i2.18678.

Gil-Espinosa, F. J. et al. (2020) 'Association of physical fitness with intelligence and academic achievement in adolescents', International Journal of Environmental Research and Public Health, 17(12), pp. 1–14. doi: 10.3390/ijerph17124362.

Giriwijoyo, S. and Sidik, D. Z. (2012) Ilmu Faal Olahraga (Fisiologi Olahraga). Bandung: Universitas Pendidikan Indonesia.

Hogarth, L. W., Burkett, B. J. and McKean, M. R. (2015) 'Activity Profiles and Physiological Responses of Representative Tag Football Players in Relation to Playing Position and Physical Fitness', PLoS ONE, 10(12), pp. 1–16. doi: 10.1371/journal.pone.0144554.

Hötting, K. and Röder, B. (2013) 'Beneficial effects of physical exercise on neuroplasticity and cognition', Neuroscience & Biobehavioral Reviews, 37(9), pp. 2243–2257. doi: https://doi.org/10.1016/j.neubiorev.2013.04.005.

Ilissaputra, D. A. and Suharjana, S. (2016) 'Pengaruh metode latihan dan VO2 Max terhadap dasar sepak bola', Jurnal Keolahragaan, 4(2), p. 164. doi: 10.21831/jk.v4i2.10892.

Ishihara, T. et al. (2017) 'Improved executive functions in 6–12-year-old children following cognitively engaging tennis lessons', Journal of Sport Science, 35 (20), pp. 2014–2020.

Ismayanti (2008) Tes dan Pengukuran Olahraga. Surakarta: Sebelas Maret University Press.

Kharisma, Y. and Mubarok, M. Z. (2020) 'Analisis Tingkat Daya Tahan Aerobik Pada Atlet Futsal Putri AFKAB Indramayu', Physical Activity Journal, 1 (2), p. 125. doi: 10.20884/1.paju.2020.1.2.2349.

Kusnandar et al. (2019) 'Pengaruh Permainan Tradisional Banyumas Gol-Golan Terhadap Tingkat Kebugaran Jasmani Siswa Sekolah Dasar Di Kabupaten Banyumas', Physical Activity Journal (PAJU), 1(1), pp. 18–26. doi: 10.20884/1.paju.2019.1.1.1996.

Latifah, E. et al. (2017) 'Contribution of Intelligence and Emotional Qoutients with Performance Athletes Pencak Silat', IOP Conf. Series: Materials Science and Engineering, 180. doi: 10.1088/1757-899X/180/1/012233.

Listiandi, A. D., Budi, D. R., et al. (2020) 'Healthy fitness zone: identification of body fat percentage, body mass index, and aerobic capacity for students', Jurnal SPORTIF : Jurnal Penelitian Pembelajaran, 6 (3), pp. 657–673. doi: https://doi.org/10.29407/js_unpgri.v6i3.14936.

Listiandi, A. D., Kusuma, M. N. H., et al. (2020) 'Pemanfaatan Aplikasi Smartphone untuk Meningkatkan Daya Tahan', Jendela Olahraga, 05(2), pp. 9–17.

Manisha (2018) 'An assessment of endurance of football players in relation to their maximal oxygen consumption', International Journal of Yogic, Human Movement and Sports Sciences, 3(2), pp. 643–645.

McLean, S. et al. (2017) 'What's in a game? A systems approach to enhancing performance analysis in football', PLoS ONE, 12(2), pp. 1–15. doi: 10.1371/journal.pone.0172565.

Milanović, Z. et al. (2015) 'Is Recreational Soccer Effective for Improving V˙O2max? A Systematic Review and Meta-Analysis', Sports Medicine, 45(9), pp. 1339–1353. doi: 10.1007/s40279-015-0361-4.

Mishra, K. M., Pandey, A. K. and Chaubey, D. (2015) 'A Comparative Study of Vo2 Max among the Basketball, Football, Volleyball and Hockey Male Players', International Journal of Applied Research, 1 (11), pp. 245–247.

Monteiro, A. M. et al. (2019) 'The effects of daily physical activity on functional fitness, isokinetic strength and body composition in elderly community -dwelling women', Journal of Human Sport and Exercise, 14(2), pp. 385–398. doi: 10.14198/jhse.2019.142.11.

Najah, A. and Rejeb, R. (2015) 'The psychological profile of youth male soccer players in different playing

positions', Advanc Physic Education, 5(3), p. 161. doi: 10.4236/ape.2015.53020.

Nakisa, N. and Rahbardar, M. G. (2021) 'Comparison of IQ, EI, Sports Performance, and Psychological Characteristics of Young Male Soccer Players in Different Playing Positions', Annals of Applied Sport Science, 9(1), pp. 1–8. doi: 10.29252/aassjournal.910.

Nurhasan, A. N. (2011) 'Tes dan Pengukuran Pendidikan Olahraga'.

Popovic, S. et al. (2014) 'Comparative Study of Anthropometric Measurement and Body Composition between Elite Soccer and Volleyball Players', Int. J. Morphol, 31(1), pp. 267–274.

Putra, K. P., Messakh, S. T. and Adhitya, Y. D. (2020) 'Cognitive Function Differences on Elderlies (> 50 years) Examined from Daily Physical Activity Intensity Differences', Jurnal Pendidikan Jasmani Dan Olahraga, 5(2), pp. 134–142.

Qohhar, W. and Pazriansyah, D. (2019) 'Pengaruh Model Pembelajaran Kooperatif Tipe Teaching Games For Understanding (TGFU) Terhadap Peningkatan Hasil Belajar Teknik Dasar Sepakbola', Physical Activity Journal. doi: 10.20884/1.paju.2019.1.1.1998.

Quindry, J., Williamson-Reisdorph, C. and French, J. (2020) 'Health and fitness benefits using a heart rate intensity-based group fitness exercise regimen', Journal of Human Sport and Exercise, 15(3), pp. 692–705. doi: 10.14198/jhse.2020.153.18.

Rahmadani, A. S. (2019) 'Karakteristik Psikometri pada Standard Progressive Matrices (SPM)', JPPP - Jurnal Penelitian dan Pengukuran Psikologi, 8(2), pp. 59–68. doi: 10.21009/jppp.082.01.

Rusdiana, A. et al. (2020) 'Vo2max Measurement Using Bleep Test with Infrared Sensor', Jurnal Pendidikan Jasmani Dan Olahraga, 5(2), pp. 134–142.

Setiawan, H., Soetardji and Nugroho, P. (2014) 'Kondisi Fisik dan Kemampuan Teknik Dasar Pemain Futsal Tim Porprov Kota Semarang Tahun 2013', Journal of Sport Sciences and Fitness, 3(4).

Shalar, O. et al. (2020) 'The correlation between intelligence and competitive activities of elite female handball players', Journal of Physical Education and Sport (JPES), 20(1), pp. 63–70. doi: 10.1002/9781118270011.

Sharma, R. (2015) 'Assessment of Motor Fitness, Physical Fitness and Body Composition of Women Football Players at Different Levels of their Participation', American Journal of Sports Science and Medicine, 3(2), pp. 47–54. doi: 10.12691/ajssm-3-2-4.

Shook, S. U. (2017) 'The relationship between physical fitness and academic achievement in sixth grade students.', Dissertation Abstracts International Section A: Humanities and Social Sciences, 77(9-A(E)), p. No-Specified. Available at: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=psyc13a&NEWS=N&AN=2016-53068-279.

Singh, S. and McMahan, S. (2006) 'Evaluation of the Relationship between AcademicPerformance and Physical Fitness Measures in California Schools', Californian Journal of Health Promotion, 4(2), pp. 207–214. doi: 10.32398/cjhp.v4i2.1946.

Sucipto, S. et al. (2019) 'The Implementation of Tactical Approach on Students' Enjoyment in Playing Football in Junior High School', Jurnal Pendidikan Jasmani Dan Olahraga, 4(1), pp. 14–20. doi: 10.17509/jpjo.v4i1.16252.

Sugiyono (2019) Metode Penelitian Kuantitatif, Kualitatif, dan R&D. Bandung: Alfabeta.

Suhartoyo, T. et al. (2019) 'Identifikasi Kebugaran Jasmani Siswa SMP Di Daerah Dataran Tinggi Kabupaten Banyumas', Physical Activity Journal. doi: 10.20884/1.paju.2019.1.1.1995.

Suwartono, C., Amiseso, C. P. and Handoyo, R. T. (2017) 'Uji reliabilitas dan validitas eksternal The Raven's Standard Progressive Matrices', Humanitas, 14(1), pp. 1–9.

Vasileios, A. et al. (2018) 'The increase of vo2 max variation and the specific biochemical parameters in soccer players after a pre-season training program', Journal of Physical Education and Sport, 18(2), pp. 686–694. doi: 10.7752/jpes.2018.02100.